

GIS and Data Services Gaining Ground in Academic Libraries

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It's the week after finals and quiet has descended upon the library and indeed over most of campus. Yet again this semester I am shocked at the flurry of activity surrounding final exam week and at how quickly it dissipates. Remaining from the crush of studying and scurrying to finish projects are scatterings of trash and crumbs and notes on the dry erase board perched above a group study area in our lab. The last scrawled message instructs the reader to awaken a certain student in the wee hours, possibly the one I saw sleeping in the women's restroom.

But after a long semester in which I taught more GIS (geographic information systems) workshops than ever, trained a new student assistant, and actually took a vacation, the day after finals was not as peaceful as I had anticipated. From a long phone conversation with a faculty member keen on using GIS in her linguistic research, to an intensive consultation with a graduate student finishing a project, to harried architecture students dropping off tons of drawings to be scanned, it was hectic from start to finish.

Our intent in writing this article is not to provide an exhaustive review of GIS and data services in U.S. academic libraries, but rather to present and discuss some topics that shed light on the subject. We write from our own relatively limited but rich experiences in delivering such services at the University of Kansas (KU). Our most attentive audience may be those working in or considering GIS and data services. Perhaps the broader community of academic library staff will find something here as well. Thus, we aspire to comment both objectively and subjectively, and apply our knowledge to the wider world of academic libraries. For those wanting a more comprehensive overview, the Association of Research Libraries (ARL) has published SPEC Kits titled *Spatial Data Collections and Services* (Salem, 2005) and *Numeric Data Products and Services* (Cook, 2001). In addition, the Map and Geography Round Table (MAGERT) of the American Library Association has released the third edition of the *Guide to U.S. Map Resources*, which includes detailed profiles of map and GIS-related services at 564 academic libraries in the United States (Thiry, 2006). One can also look to related publications such as the Fall 2006 issue of *Library Trends*, which focuses on GIS and libraries (Stoltenberg and Parrish, 2006). Finally, one can find an assortment of pertinent information in databases such as Library Literature, GeoBase, General Social Sciences, and other relevant indexing services, as well as in conference proceedings.

We refer herein to data-related services in general and at KU in particular as "GIS and data services." By "data," we refer to information, generally in a digital

tabular or textual format, i.e., information that is not in a visualized format (charted) or presented in a geographic context (mapped). By “GIS” or “spatial data,” we refer to information in various geospatial formats, and having a geographical component or referenced by location on the earth’s surface. The term “GIS” or geographic information systems refers to the spatial data, software, and people that interact to compose such a system.

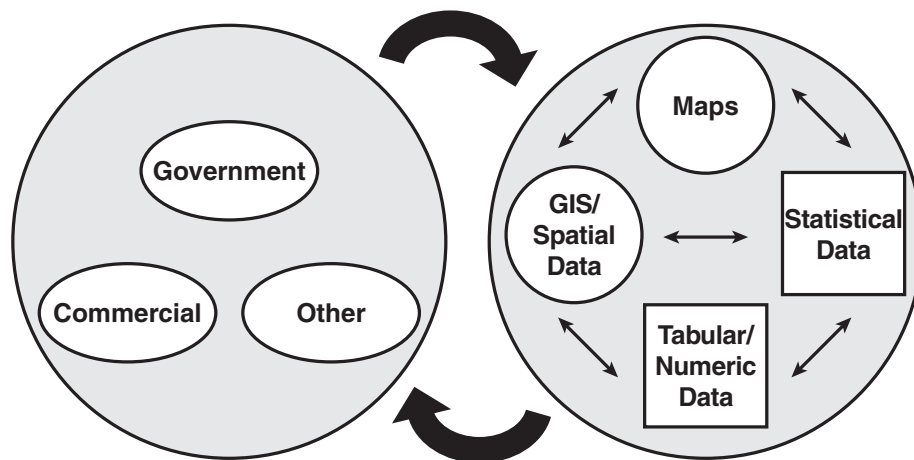
—Rhonda Houser

Where We Came From, Where We Are Now

More than 29,000 students and 2,200 faculty members make up the academic community of the University of Kansas, which now offers more than 170 fields of study and includes 14 schools. The KU libraries are under the administrative umbrella of Information Services, which also includes Information Technology. Library collections consist of approximately 3.7 million volumes and 33,000 current serial titles, housed in six facilities in Lawrence and one in Kansas City.

KU Libraries, Information Technology, and the Policy Research Institute founded a campus committee several years ago called the Academic Data Research Services Alliance (ADRSA, <http://www2.ku.edu/~adrsa>). Working through ADRSA, these founding partners were instrumental in establishing the libraries’ GIS and Data Lab and the “GIS and data specialist” position. Many larger academic libraries offer some combination of services for data, GIS, government information, maps and statistics, due to natural overlap in these areas. Figure 1 illuminates interaction among sources and providers of data-related information, and application of that information. However, these services tend to differ, depending on the campus and library environment, in availability of data, software, labs, and staff. KU Libraries GIS and data services is closely aligned

Figure 1 / Data Sources and Resources



The sources (at left) of maps and various data types (at right) include government (open access, freely available), commercial (proprietary), and other (academic, non-profit). A kind of “data cycle” is perpetuated when researchers generate more data and/or derive information from data use.

with government information, maps, and statistics units in supporting related coursework, research, and teaching on campus.

The GIS and Data Lab <http://www.lib.ku.edu/gis>, centrally located in one of the two larger campus libraries, provides quiet work and consultation space for individuals and groups. Our lab is one of two on campus that support data-related work, regardless of departmental or other KU affiliation. The lab was originally located at the back of a small library meeting room, with two workstations set up for social science data users. The T. R. Smith Map Collection provided basic GIS assistance, and a data librarian offered limited assistance to lab users. Hiring a full-time GIS and data specialist in 2002 resulted in the lab being set up for both numeric and spatial data users. In 2004 we began merging with the campus statistics lab, endorsed through ADRSA but located in a different building. Lab use has gradually risen since our beginnings, probably due to increased resources and staff, and moving from appointment-only use to open lab hours. We now occupy a larger room next to the map collection, and staff members with expertise in data, GIS, government information, maps, and statistics are nearby.

Lab users have access to seven workstations loaded with major GIS and statistical applications, small scanners and printers, and oversize scanning and printing services. Nearly all workstations have log-ons for user authentication, consistent with other public-use machines in the libraries, and standardized images, so that all computers are loaded with (nearly) the same set of programs. Users have dedicated network space for data storage but are encouraged to use this as temporary space. The libraries just received several long-awaited 20-inch monitors to improve visualization capabilities for spatial data. Additional lab resources include reference books, software manuals, data sets, tutorials, and current publications.

The GIS and data specialist and the data librarian teach workshops throughout the semester. GIS workshops are designed to cover basic to advanced skills, as well as specialized topics, such as spatial analysis. GIS lessons teach familiarity with the software, but more importantly show users how to work with spatial data and apply geographic concepts. The GIS specialist also provides custom training sessions, such as "Moving from ArcView 3.x to ArcGIS," given to staff members at a campus research center. More commonly, the GIS specialist works with instructors to develop GIS workshops for specific classes or projects. Disciplines that regularly request this service are architecture, ecology and evolutionary biology, geography, public administration, and urban planning. Data instruction focuses on aiding researchers to identify and access needed data. A regularly offered workshop provides an overview of major data resources, including library-licensed resources, as well as strategies for tapping into online data created by the government and other entities. Finally, the libraries' statistical consultant offers workshops geared to use of the main statistical computing packages, SAS (Statistical Analysis System) and SPSS (Statistical Package for the Social Sciences). All workshops are integrated into the KU Libraries instructional services unit. We also provide training sessions, presentations, and tours for library staff members and others as needed. One-on-one instruction is a major component of the service, which is provided in person and via e-mail and telephone. Tasks for which researchers often need assistance are listed below, followed by some specific examples.

- Finding, identifying, or gaining access to specific datasets
- Generating a map or image from spatial data
- Converting data among various formats
- Devising and running analyses of datasets
- Subsetting or clipping datasets
- Creating and editing data, such as point, line, or polygon features
- Mapping tabular data using geographic coordinates
- Formatting and mapping tabular data by linking (joining) to a GIS layer
- Integrating an image, such as a scanned map, into a GIS by georeferencing
- Examining relationships among layers, or spatial data analysis

Example: Mapping and Analyzing Magazine Readership Data

A journalism professor wished to examine *Saturday Evening Post* readership (circulation) data for U.S. counties and states, in a geographical context. With some assistance, he was able to link (join) the *Saturday Evening Post* data to existing spatial data for county and state boundaries. He then manipulated the data to visualize how readership varied across the United States, and changed over time. We then helped him find U.S. Census of Population and Housing data for 1900 to 1930. He wanted to use GIS or statistical tools to investigate the population characteristics in different geographic areas and years of readership. This researcher's work incorporated a range of GIS and data services as he obtained various formats of data from multiple sources, with the assistance of the data services librarian, the statistical consultant, and the GIS and data specialist.

Example: Finding and Mapping GIS Data for a Metropolitan Area

A public administration faculty member contacted us about using GIS in her urban and metropolitan politics classes. She wanted to demonstrate how geographic and cultural features represented by GIS data (city/county boundaries, roads, watersheds, and so forth) do not adhere to jurisdictional boundaries in metropolitan Kansas City, composed of multiple counties in two states. We quickly found abundant spatial data layers online, through a regional planning organization. The data were already formatted to her area of interest, and we were able to download and use them with no problems.

Example: Mapping an Archaeological Site in Europe

This example encompasses GIS, data, and mapping resources, and is similar to other help sessions in this respect. A Ph.D. student in anthropology needed assistance with mapping an excavation site in France. She used a grid to represent the dig site, as if draping a large net over it. Her instructor had helped her with the complicated and laborious task of converting grid coordinates from alpha/numeric coded cells to relative latitude/longitude coordinates. We then formatted this spreadsheet data as a database (DBF) file (no longer necessary with ArcGIS 9.2—it reads Excel files). Next we brought the DBF file into ArcGIS using the geographic coordinates, which worked the very first time. This meant that loca-

tions where tools or other artifacts were found, previously represented by grid cells, were now shown as points. The student also had a hard copy site map that she wanted to incorporate, so she scanned the map on our smaller scanner. We then sat down in front of ArcGIS again and walked her through georeferencing, or aligning the digital map with her artifacts (point) layer.

Data Management

GIS and data resources come from various sectors, and have different types of access and copyright protocols. In developing our services, we felt it was important to survey library spatial data, including federal depository, commercial, and internally generated data. However, a discrete “snapshot” inventory proved difficult, as these items are underused and difficult to find using conventional library search/cataloging tools. Thus, inventory is ongoing through data requests, coincidental discovery, collection development, and monitoring of new resources.

Much of the content used in GIS, and even data analysis, is “open access” (OA) or freely available, from such producers as government agencies. U.S. government data, at the federal, state, and local levels, composes a large and vital component of patron data usage. The annual budget is one indicator of the volume of data and statistics available from the U.S. government. The Office of Management and Budget issues an annual report, “Statistical Programs of the United States Government,” which tracks government programs and agencies that spend more than \$500,000 a year in creation and dissemination of statistics. In fiscal year 2007 this comprised more than 80 different federal agencies or programs and totaled more than \$5.4 billion in planned expenditures for the year. Most of this information will be freely available for public use. The U.S. Geological Survey and Census Bureau produce much of the spatial data in use, but spatial and statistical data also come from numerous agencies across the federal government. Some of the major governmental areas that provide statistical data are the Bureau of Labor Statistics, Census Bureau, Citizenship and Immigration Services (formerly the Immigration and Naturalization Service), Department of Agriculture, Department of Education, Department of the Interior, the Federal Reserve System, the Department of Health and Human Services, and the Social Security Administration.

Data from other nations may not be available as described above. National and international governmental organizations provide some level of data or statistics in OA fashion, particularly the United Nations, European Union, World Bank, and the Organization for Economic Cooperation and Development (OECD). Also, many resources, particularly for data services, require funding and licensing to gain access. The following are examples of licensed/purchased resources from KU Libraries:

- ICPSR Data Archive—a large-scale archive of more than 6,500 different data sets including census data, opinion poll or survey data, voting and election records, or data of other social and demographic natures

- United Nations Common Database—longitudinal socioeconomic data from more than 40 different producing organizations, including 160 different variables, for nations of the world
- World Bank Databases—including World Development Indicators and Global Development Finance
- LexisNexis Statistical—approximately 40,000 statistical tables as well as indexing to U.S. and other governmental publications that include statistics
- Source OECD—online version of OECD publications and databases that include large amounts of time-series statistical information
- Historical Statistics of the United States—more than 28,000 time-series statistical indicators from the colonial era to the present covering social, demographic, economic, and business topical areas

We seldom purchase data sets, as a plentitude of digital data is freely available online and through government agencies, as noted above. Moreover, availability of library staff to assist with data manipulation decreases the need for acquiring many datasets. We do not have separate funding for data and related resources, so we coordinate with the appropriate subject liaison when this need arises. Considering the strengths of our sheet map and data holdings, and freely available data, we will focus any future spatial data Acquisition efforts on large-scale data for places outside the United States and Canada, or other proprietary data as may be relevant to a research project and for which funding can be secured. An important criterion for considering acquisition of a data-related resource is its capability to use information in a tabular format, such as comma-separated-value (CSV) tables, or other formats that can be readily imported into data analysis programs such as SAS and SPSS. Additional data resources we would like to acquire include the Roper Center's iPoll and Gallup Brain, major collections of opinion poll and survey data. Incorporating campus-generated data sets into such archival and access tools as our institutional repository and the state GIS clearinghouse is another key aspect of data management.

GIS and Data Services Big Picture

In looking at GIS and data services in academic libraries across the United States, we assume that examining organization and conference participation, e-mail listservs, job openings, and so on will give us a clearer picture of such services. This article is intended to provide selective commentary on such services.

Libraries are not the sole location on an academic campus that may provide support for GIS and data work. Other places include relevant departments and research centers, including, for instance, ecology, geography, geology, and urban planning for GIS, and sociology and political science for data. Other sites for GIS/data support could include campus computing centers, research centers, schools, and so forth as these units generally possess necessary resources and

technology. Given the information on the provenance of GIS/data services, we believe that academic libraries are one of the most logical and effective campus units for providing institutional support for GIS and data services. The traditional function and purpose of the library is to be a centralized, long-term academic resource for the campus, and to provide integrated access to information across all disciplines, in support of teaching, learning, and research. These services include identifying, acquiring, describing (cataloging), and preserving information, and providing related user services such as discovery tools, instruction, and reference. Situating GIS/data services in the library provides an opportunity to connect with numerous disciplines and research areas, including supporting those where GIS/data use is more established, and building interest in disciplines where GIS and data have potential applications.

To support logical placement of data services in libraries, we offer the following information. The Inter-University Consortium for Political Science and Research (ICPSR) is a large-scale social and political data archive that has existed for more than 40 years. ICPSR provides long-term preservation of and access to a large and growing collection of social science data sets for research. Consortium membership comprises more than 500 colleges and universities around the world. ICPSR campus memberships are coordinated by an “organizational representative” (OR) who is the official contact at the member institution, the campus representative to ICPSR, and who supports academic use of ICPSR collections and services. As of autumn 2005, 41 percent of ICPSR ORs were housed in their respective institutions’ academic libraries, the single largest campus setting for ORs. The next most common OR sites were sociology or general social sciences at 26 percent, political science at 15 percent, and campus computing or data centers at 13 percent and 11 percent, respectively (e-mail communication from Linda Detterman, ICPSR marketing and membership director, January 2, 2007).

The number of GIS and data-related job openings in academic libraries may also speak to the activity in this field, as we now see regular postings to relevant listservs for such positions. Some of the listservs or other electronic alerting services for employment opportunities in libraries include GIS4LIB-L, MAPS-L, GOVDOC-L, IASSIST-L, LIBJOBS-L, and position announcements in the *Chronicle of Higher Education*. In these lists, position announcements that mention GIS/geospatial and/or numeric data responsibilities, if not specifically as GIS or data librarian and the like, have become quite common. For example, the archives of the GIS4LIB and MAPS-L listservs contain 25 and 85 such job announcements, respectively, over the past five years. In addition, the IASSIST Web site showed 30 job postings in 2005 and 2006 for data-related positions. Other positions in libraries, particularly for cataloging and technical services, have begun asking for familiarity in GIS and data areas, most likely due to their growth and higher visibility. Joshua Been, GIS librarian at the University of Texas at Arlington, has built an online map that allows GIS librarians and specialists around the world to map their locations and view others working in this field. This relatively new application already includes some 80 entries. Librarians can put themselves on the map at <http://www.frappr.com/gislibrarians>.

Organizations and conferences relating to GIS and data include MAGERT (<http://www.ala.org/ala/magert/magert.htm>), a forum for those interested in map and geography librarianship that includes more than 380 members. IASSIST, the International Organization for Social Science Data Information Service and Technology (<http://www.iassistdata.org>), includes professionals in data services and information technology who support research and teaching in the social sciences. Membership totals 300, working in data archives, statistical agencies, research centers, libraries, academic departments, government departments, and nonprofit organizations. Members involved in GIS are increasing but are a minority. Both MAGERT and IASSIST hold annual conferences and produce map, GIS, and data-related publications. The ESRI Education User Conference (<http://www.esri.com/events/educ/index.htm>) is being held again in the summer of 2007, in conjunction with the International ESRI User Conference. ESRI, or the Environmental Systems Research Institute, is the maker of ArcGIS software. The education conference is a forum for those working with GIS in higher education to share their knowledge and experiences. In 2006 some 650 educators attended this conference (Kerski 2006). ESRI provides numerous publications and tools relating to GIS in higher education.

Membership in data-related electronic mailing lists may also be illustrative of GIS and data services in academic libraries. GIS4LIB (<http://mailman1.u.washington.edu/mailman/listinfo/gis4lib>) is an e-mail discussion list for issues relating to GIS and libraries of all types. Possible topics include collection development, data acquisition, hardware, licensing, and software. As of December 2006 a total of 305 people were subscribing to the GIS4LIB list (e-mail communication from Matthew Parsons, list moderator, December 22, 2006). MAPS-L, or Maps and Air Photo Systems Forum (<http://www.listserv.uga.edu/cgi-bin/wa?SUBED1=maps-l&A=1>), is an international e-mail discussion list for issues relating to libraries and cartographic information such as cartography, GIS, remote sensing, and geography. As of January 2007 this list included 1,024 subscribers, of which roughly half seemed to be affiliated with U.S. academic institutions. ESRI-L (<http://support.esri.com/index.cfm?fa=listserv.listserve>) is an e-mail discussion list for users of ESRI (GIS) software, so participants range much more broadly than the “library world.” IASSIST-L is the listserv of the organization of the same name described above, and included 357 members as of January 2007. Of these, more than half appeared to be affiliated with U.S. and Canadian universities. GOVDOC-L (<http://govdoc-l.org>) is a list for library professionals and others who work with government information (U.S. federal, state, local, and international). Major themes in postings include collection development and processing, requests for assistance from colleagues to support users, and larger policy and logistical issues surrounding the provision and access of government information to the public. GIS and data topics are common to many postings. Subscription numbers for GOVDOC-L numbered about 2,500 in early 2007 and that number has been fairly consistent or growing over past years (e-mail communication from Jennie Gerke, list moderator, January 10, 2007). Thus we conservatively conclude that listserv members at academic institutions are frequently housed in the campus library, or functional equivalent.

Future Directions

GIS use seems to be spreading steadily across many campuses, appealing to more and more fields of study. At KU, the GIS specialist has observed recent interest in the fields of anthropology, journalism, linguistics, political science, and public administration. Many departments may have a few users, but neither staff nor facilities to support GIS. These users need access to software, data, educational resources, and staff expertise from a centralized, accessible source of research assistance. Increasing interoperability among data formats, may be both a contributor to and result of multi- and interdisciplinary use of GIS. Raster, vector, and tabular formats are crossing proprietary and disciplinary boundaries. For example, many of our users in architecture and urban planning regularly must convert among CAD, 3D, and GIS data. Also, ArcGIS software is accepting or providing conversion tools for more and more formats, such as CAD, Excel, and JPEG 2000. We have also seen GIS software moving from the more conventional 2D or XY realm to being more supportive of visualizing data in a 3D or XYZ environment. Users in architecture and geology find 3D capabilities particularly useful. In addition, in applications such as ArcGIS, users can bring in a fourth dimension and examine change over time as well as space.

A prevailing GIS trend is evident in the streamlined mapping applications that provide access to data (global satellite imagery) and custom tools (zoom to an address or location). Examples of “GIS for the masses” software include the free versions of ESRI’s ArcExplorer and GoogleEarth, which require little or no training to use. We especially appreciate GoogleEarth’s color imagery of places for which freely available data are difficult to find. Architecture and urban planning students and faculty have found GoogleEarth’s detailed 3D building data very useful for the same reason.

Another strong wind in the world of GIS is the proliferation of online mapping sites, where users can interact with spatial data, e.g., zoom, pan, and sometimes download. These Internet mapping services (IMSs) often replace or are offered as alternative ways to view and acquire data, compared with more conventional access methods such as ftp. Based on the current landscape, we also forecast that more spatial data will be accessible in metadata catalogs. In addition, one can increasingly connect to and use data sets in GIS software, via the Web, instead of downloading and using from a local machine.

Some disadvantages to using data from the Web, whether through an IMS application or by connecting to data online from GIS software, include:

- Limited functionality—one is often unable to view, sort, or query data attributes, or change how data are displayed, e.g., which variables are mapped
- Performance may be too slow to be useful, depending on site architecture, local system and software setup, size of data set, and so forth
- Metadata is often inaccessible, if available at all

Some advantages include being able to

- Quickly preview data before downloading and processing

- Choose a custom geographic area, projection, and so forth, and have dataset generated dynamically
- Access data via an IMS without having to download data and use in desktop GIS software
- Use spatial data without having GIS expertise

Although our campus niche at KU is not to provide spatial data, we do generate data from time to time through special projects. One such project involves georeferencing historical aerial photographs for our county. The resulting sets of rectified images can be used independently or with other spatial data in a GIS. We are working with staff at the state GIS clearinghouse to develop an IMS for these air photos, which will also include current imagery. Many GIS users, including campus instructors and researchers, and city and county officials, anticipate having access to such rich and widely applicable datasets, representing six decades of change.

Another project in its final phase is a jointly managed effort between our lab and map collection, the university's geography department, and the Kansas Applied Remote Sensing Program to scan and rectify sheet maps from the Joint Operations Graphics or JOGs series produced by the National Geospatial Intelligence Agency. Our part in providing and scanning more than 1,200 maps is essentially complete. We plan to make the rectified images available to our users, perhaps in a manner similar to the air photos. The sheet maps have been a sought-after resource that many users incorporate into a GIS; thus the rectified images should also prove very useful.

We intend to fully merge the lab with the campus statistics lab in the coming year to better serve our users and make our work more effective. This includes creating one Web site, more coordination of other outreach and training activities, and achieving standardized images for all workstations. In the coming year, we hope to receive new lab workstations, so that all public machines are alike and management and maintenance simplified. We would also like staff members to track GIS, data, and statistics consultations using a common database, which is available but not collectively utilized. We also seek to increase awareness of KU's GIS and data services, both within the library and across campus. In all of this, we work toward becoming a sort of campus nucleus, in both an in-person and digital sense, for all aspects of data use, including access, instruction, integration with curriculum, analysis, software licensing, and so on.

Use of non-spatial data has also been growing at the university, albeit more slowly than GIS use. Political science, economics, and other departments are significant data users, as would be expected. But more faculty in other disciplines are becoming interested in incorporating data use and analysis into their research, by creating their own data or using existing data, and in building data use into their class curriculum. We have started to see more undergraduates needing to access and analyze existing data as part of class assignments, particularly in economics, political science, and business. Interest is also growing in having greater curricular programming to aid in developing quantitative literacy or numeracy. This would address goal 3 of the KU Goals of General Education: "Improve the core skills of reading, writing, numeracy, and enhance communication by clear,

effective use of language” (<http://www.registrar.ku.edu/goals.shtml>, viewed January 10, 2007). This connects into a nationwide emerging interest for increasing quantitative literacy in the national educational system.

KU has long been known as a strong advocate for a more open access treatment of scholarly knowledge and research outputs, believing that such information should be available to researchers without barriers of subscription or licensing. As a result, the university now has an institutional repository, KU ScholarWorks (<https://kuscholarworks.ku.edu/dspace>), as a mechanism for KU researchers to house and provide access to their research literature and data that may be published in journals or elsewhere. Although GIS and data work are not yet a presence in KU ScholarWorks, the potential is there. KU has also instituted some additional new services in support of large-scale data use. The Andrew File System (AFS) is a fully supported networked storage environment for working datasets created by campus researchers and any collaborators external to KU. AFS is an open-source system built collaboratively by academic institutions across the United States to provide a sustainable, scaleable, and transferable system that can be implemented in research environments (<http://www.openafs.org>). KU has also established a new research computing service to aid in statistical and intensive numerical computing needs. IRES, or Instruction and Research Statistics and Numerical Server, provides storage and computing accounts for both research and classroom needs (<http://ires.ku.edu>).

As we move forward in a digital world, with much communication and work occurring in an environment of computers, networks, and digital content, the term “cyberinfrastructure” has come to refer to all components of this networked environment. GIS and data services are inherently technology-intensive and rely heavily, if not critically, on a robust and functioning cyberinfrastructure. Therefore, some recent efforts emerging from the National Science Foundation (NSF), the American Council of Learned Societies (ACLS), and the Association of Research Libraries (ARL) are worthy of note.

Two major reports over the past few years address the critical issue of cyberinfrastructure development in education and industry. The first, “Revolutionizing Science and Engineering Through Cyberinfrastructure” (<http://www.nsf.gov/od/oci/reports/toc.jsp>), was initiated and funded by the NSF Blue Ribbon Advisory Panel on Cyberinfrastructure to investigate the need to create a robust and dynamic information infrastructure that would adequately support future scientific research. As a result of the groups’ findings, NSF created a new Office of Cyberinfrastructure (OCI) to lead cyberinfrastructure developments in NSF-funded research and activities. OCI provides oversight and leadership for cyberinfrastructure, as well as funding opportunities for related research.

The second cyberinfrastructure report resulted from examination of cyberinfrastructure needs and opportunities in the arts, humanities, and social sciences, as this may not have been part of the NSF effort. ACLS, another organization providing disciplinary oversight, initiated this process. This report, titled “Our Cultural Commonwealth” (http://www.acls.org/ex-cyber_report.htm), outlines the process and findings of the ACLS investigation of cyberinfrastructure needs for the humanities, and the importance of addressing those needs for future teaching, learning, and research.

In September 2005 the National Science Board, a component of NSF, issued the report “Long-Lived Digital Data Collections: Enabling Research and Education in the 21st Century” (<http://www.nsf.gov/pubs/2005/nsb0540>), outlining challenges and opportunities presented by the increasing body of digital data generated by research and learning. “Data” as defined in the report encompasses all forms of information created and stored in digital form, including text, numbers, images, sound, software, programming, models, and simulations. So although broader than GIS and data in our context, it clearly encompasses these. The report outlines significant issues relating to creation, storage, description, transmission, and access to data collections in standardized and sustainable ways. Standardized and sustainable methods are particularly critical to ensure that people can still use data in environments where technologies, skills, and other supports may vary. These methods also seek to ensure that data created today is adequately preserved for future use, accounting as best as possible for changes in technologies.

The interest and potential role of academic libraries in these issues is reflected in a 2006 workshop, “New Collaborative Relationships: The Role of Academic Libraries in the Digital Data Universe” and the resulting report “To Stand the Test of Time: Long-Term Stewardship of Digital Data Sets in Science and Engineering” (<http://www.arl.org/info/events/digdatarpt.pdf>). In this effort, ARL and NSF envisioned the needs and roles of libraries and others in supporting digital data. Although the explicit focus of this workshop and report is “science and engineering,” it potentially speaks to all forms of data without respect to discipline. Two major library roles in stewardship of this data universe are to provide leadership and expertise in preservation and curation. Preservation is defined as standards-based management to guide data throughout its life cycle, aimed at long-term usability. Curation is defined as processes for organizing, displaying, and repurposing the data.

We do not presume to have addressed every aspect of GIS and data services in academic libraries. Rather, we have provided an overview of such services from our unique perspectives, and we hope that this information is helpful to others in our field. These issues are probably most applicable to the academic library environment, but may be transferable to other library settings. We do believe that these services fit well in an academic library, given the array of topical applications for GIS and data use, the associated issues of long-term preservation of information, appropriate description and management of the information, and the need for helpful and informative user support to library patrons as they make use of GIS and data. We have briefly described the evolution of GIS and data services at KU, how various components relate to larger-scale issues that may impact our services, and how we plan to prepare for these future challenges.

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